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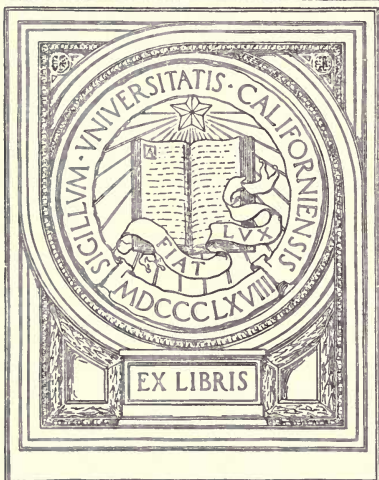


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ENGINEER DEPARTMENT LETTER FROM THE SECRETARY
REVEY FOR A HARBOR OF REFUGE AT NEW BUFFALO, MICH.



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LETTER

FROM

THE SECRETARY OF WAR,

TRANSMITTING

A communication from the Chief of Engineers, dated the 14th instant, covering copy of report from Maj. J. A. Smith, Corps of Engineers, upon a survey for a harbor of refuge at New Buffalo, Mich.

DECEMBER 19, 1881.—Referred to the Committee on Commerce and ordered to be printed.

WAR DEPARTMENT,

Washington City, December 16, 1881.

The Secretary of War has the honor to transmit to the United States Senate, for the information of the Committee on Commerce, a communication from the Chief of Engineers dated the 14th instant, covering copy of report from Maj. J. A. Smith, Corps of Engineers, upon a survey for a harbor of refuge at New Buffalo, Mich., made in compliance with the requirements of the river and harbor act of March 3, 1881.

ROBERT T. LINCOLN,

Secretary of War.

The PRESIDENT *pro tempore*
of the United States Senate.

OFFICE OF THE CHIEF OF ENGINEERS,

UNITED STATES ARMY,

Washington, D. C., December 14, 1881.

SIR: To comply with requirements of the river and harbor act of March 3, 1881, I have the honor to submit herewith a copy of a report to this office from Maj. J. A. Smith, Corps of Engineers, of results of a survey, made under his direction, for a harbor of refuge at New Buffalo, Mich.

Very respectfully, your obedient servant,

H. G. WRIGHT,

Chief of Engineers, Brig. and Bvt. Maj. Gen.

Hon. ROBERT T. LINCOLN,
Secretary of War.

SURVEY FOR HARBOR OF REFUGE AT NEW BUFFALO, MICH.

UNITED STATES ENGINEER OFFICE,
Indianapolis, Ind., October 10, 1881.

GENERAL: I have to submit the following report of a survey for a harbor of refuge at New Buffalo, Mich., and an estimate of the cost, as required by section 3 of the river and harbor act, approved March 3, 1881.

* * * * *

On the 3d of June, I instructed Assistant Engineer O. L. Petitdidier to proceed to New Buffalo, and make a careful survey of a portion of the lake adjacent to the town, and also of a part of the interior swamp and creek known as Lake Pottawatomie. * * * The field work has been carefully reduced, * * * and the map is forwarded in a separate package to accompany this report.

New Buffalo is situated near the south end of Lake Michigan, and about 10 miles east of Michigan City, Ind.

In 1867 the sum of \$60,000 was appropriated for the improvement of the harbor. The following appropriations were subsequently made for the same purpose; in 1870, \$5,000, and in 1871, \$500.

The subject of the improvement of this harbor was referred to a Board of Engineers in 1868, whose report was adverse thereto; but the appropriation act having directed the execution of the work, there was no other course to pursue than to commence the project with the means appropriated, and submit the result of the experiment, in order that Congress might determine whether the improvement should be continued.

The Board of Engineers estimated the cost of improvement at \$500,000.

Of the amounts appropriated, \$65,000 were expended in constructing piers and dredging a channel. The improvements made were never sufficient to attract or accommodate any commerce, and at present there are no commercial statistics to report.

The place is in the collection district of Chicago, and the nearest light-house is at Michigan City, Ind.

During the few years in which I have been charged with these works several vessels have been wrecked at and near Michigan City, principally because the incomplete condition of the outer harbor there made the entrance difficult; but I have not known, and cannot learn of any vessels having been driven ashore at any point nearer New Buffalo than the one named.

Undoubtedly a good harbor of refuge would attract a considerable commerce, and in addition would build up many local interests, but to what extent is a matter for conjecture only.

There are no engineering difficulties in the way of building a harbor suitable for a refuge, but it will involve considerable expense.

A harbor of refuge, to fulfill its object, must cover a sufficient area and depth to enable vessels to enter, "round to" or "wear" into the wind, and ride safely at anchor.

In addition to this, it is very desirable that the protection be so arranged that vessels may safely enter and leave the harbor without incurring the expense of towing.

The direction of the shore line at New Buffalo is approximately north-east and southwest, while the winds which would make a shelter necessary are from northerly directions. The drift caused by these winds is not large, though the bottom is composed of a sand which is easily moved. No observations have been made as to the direction of the drift, but a study of the map indicates that it is from northeast to southwest.

The sand is in places very coarse, like gravel, and overlies a stratum

of very hard clay; this clay is found at a depth of 24 feet near the shore, and 32 to 37 feet at a distance of nearly one-half a mile into the lake. The stratum of sand becomes less in thickness as it extends into the lake, and at a distance of one-half a mile it varies from 3 to 11 feet in depth, so far as ascertained from the soundings taken.

This affords a good support for a breakwater and piers upon foundations of piles driven through the sand into the clay. The superstructure of such works cannot be made permanent if constructed after the method heretofore employed in our harbor improvements, because the best of timber will decay sooner or later, and unless carefully watched and repaired will not only be itself a loss, but, by uncovering the portions below, will permit them to be emptied of stone, and destroyed.

The method I am now employing at Michigan City not only prevents any settling of the cribs but holds them so firmly in position that they are not moved in heavy gales occurring before the superstructure is added. This permits the engineer to build the superstructure at once, thus saving the expense of the temporary wooden work with other numerous and expensive contingencies.

My estimate for a breakwater is therefore made for the first cost of a work with the usual superstructure of timber and loose stone, with a second estimate for the same if built with a superstructure or parapet of concrete masonry faced with stone. This method, though more expensive at first, will be a great ultimate economy.

Upon the map I have indicated in broken lines, the positions and lengths of a breakwater and piers to enclose a harbor for refuge entirely outside the line of the shore.

At a point about 2,400 feet from the shore and in the prolongation of the present east pier in water 30 feet deep, a line of breakwater is commenced and extended directly eastward a distance of 1,500 feet.

It is proposed to extend a second breakwater 1,500 feet in a south-westerly direction, making an angle of 120° with the first, and leaving an opening of 400 feet at the angle.

As heavy winds will cause seas and currents to pass along the faces of the breakwater, two entrance piers are planned, one of 300 feet, the other of 200 feet in length; the longer pier on the northeast side.

As a further protection to the harbor, and to prevent its becoming filled with drift, piers are planned extending from the shore to points 200 feet inside the extremities of the two wings of the breakwater.

The plan above proposed will fulfill all the requirements of a harbor of refuge of as small dimensions as I consider prudent for any practical use. Were there at present any commerce to accommodate, it should be made larger rather than smaller.

I estimate the expense of this work as follows:

1st. If built with superstructure of crib-work—

3,500 linear feet of breakwater and entrance piers, 35 feet wide, at \$175 per foot.	\$612, 500
Piers from shore, 12 to 20 feet wide, 3,000 linear feet, at \$50.....	150, 000
Contingencies, nearly 5 per cent.....	37, 500

Total..... 800, 000

2d. If covered with superstructure and parapet of masonry, the main body of work below water being as before—

3,500 feet, foundations and crib-work, at \$125.....	\$437, 500
Superstructure and parapet for same, at \$75 per linear foot.....	262, 500
Foundation and crib-work for 3,000 linear feet of shore-piers, at \$40 per linear foot.....	120, 000
Superstructure and parapet for same, at \$35 per linear foot.....	105, 000
Contingencies, nearly 5 per cent.....	45, 000

Total..... 970, 000

Although I consider the foregoing plan decidedly the better one for a harbor of refuge, I submit a second, which consists of deepening a portion of the swamp and creek, and connecting the harbor thus made with the lake by a channel 300 feet wide, protected by piers.

The plan here indicated is as follows:

Two parallel entrance piers, 300 feet apart, to extend into water 24 feet deep; the northeast pier to be in the prolongation of the old pier.

The inner basin to be made with a wharf front parallel to and 600 feet from the outer line of Mechanic street. The eastern part of the basin to be 800 feet wide, and its extent to be determined by the railroad which now crosses the swamp; the western portion to be about equal in area, the outer line being parallel to the adjacent shore of the lake. The positions of the piers and outlines of the inner basin are indicated on the map in broken lines. The outer and inner lines of the basin are prolonged to indicate that the size of the basin may be almost indefinitely extended beyond what is called for in this project, should the demands of commerce at any future time make it desirable.

As a commercial venture the basin thus outlined would be superior, and would cost less for maintenance than the outer harbor; but as a refuge simply, it cannot be urgently recommended.

I estimate the cost of this work as follows:

4,400 linear feet of piers, composed of pile foundations supporting crib-work filled with stone, at \$75	\$330, 000
Dredging channel 300 feet wide, to a depth of 16 feet, 155,000 cubic yards of material, at 25 cents	38, 750
For construction of basin 2,500 feet long, 600 to 800 feet wide, and 16 feet deep, as outlined on map, dredging and removing 900,000 cubic yards of material, at 25 cents	225, 000
Contingencies of price, &c.	56, 250
Total	650, 000

Very respectfully, your obedient servant,

JARED A. SMITH,
Major of Engineers.

Brig. Gen. H. G. WRIGHT,
Chief of Engineers, U. S. A.

REPORT OF MR. O. L. PETITDIDIER, ASSISTANT ENGINEER.

INDIANAPOLIS, July 21, 1881.

SIR: I have the honor to report that in accordance with your instructions * * * I reached New Buffalo on June 6.

With the exception of a few unimportant details which were taken from a former map in the office, the data given are entirely from my note books.

The height of water surface at time of sounding was referred to a bench-mark (shown on the map at south end of east pier), the bench-mark being 6.72 feet above water surface.

The only change noticeable since the latest map was made was that the Chicago and Michigan Lake Shore Railroad have made an embankment of sand over their bridging, or rather trestling, across Pottawatomie Lake; they have of course left an opening for Galien River; the other changes border more on a general state of dilapidation, owing to a want of attention to repairs which have been necessary from time to time, but have never been made.

The inner piers, being washed by the water of the creek, have decayed much more rapidly than the east pier outside the harbor.

The west pier and the smaller east pier inside are now beyond repairs.

The outside east pier is, in some of its parts, in a fair state of preservation, while others will rapidly go to ruin unless soon restored.

The borings were made with a water-jet from a force-pump having a rubber hose

attached with different lengths of 1½-inch gas-pipe, which were connected as the pipe descended.

In ordinary sand the pipe sank very rapidly. I can give no exact figures, but it was as fast as a man could conveniently lower it.

To ascertain the nature of the bottom an auger mounted on a ¾-inch gas-pipe was used, and the finding and bringing up samples of the material was along and on the outside of the pipe, it being found that the sand washed out from the bottom left a large conical hole through which the bottom was easily reached. The whole apparatus was on a raft put together in one hour.

I contented myself with going to the clay, whenever possible, so that I do not know its thickness.

In the inner harbor clay was struck but once. All the rest of the borings passed through a stratum locally called "muck," which is very viscous in its nature without being as cohesive as the clay.

A depth of 28 feet was bored through the muck, but it was very difficult to withdraw the pipes, as the holes washed out by the jet of water were only large enough for the pipes to pass through. I therefore desisted trying to reach the clay.

I have been informed that the Michigan Central Railroad Company, in driving piling to carry their track to the lake, when near the boring marked No. 3 on the map, drove three piles, end to end, until a depth of 90 feet was reached, without any solid bottom.

The citizens have appointed a committee on harbor improvement, and raised about \$7,000 to continue to construct an outside west pier; they have appointed an engineer, and seem to be pushing matters vigorously.

When I left New Buffalo, at the close of the survey, they had already on the ground some 200 piles 35 feet long, and were waiting before commencing work for advice as to the best method of construction.

The survey was completed June 25. * * * The elevation of numerous points above the water has been determined, and is indicated on the map, preceded by the sign (—). Number of soundings taken and located is 1,667.

Number of borings, 18.

Boring No. 1.—Water, 7 feet; muck, 5 feet; depth to clay, 12 feet.

Boring No. 2.—Water, 8.5 feet; gravel, 1.5 feet; through muck, 13 feet; total depth, without reaching clay, 23 feet.

Boring No. 3.—Water, 8 feet; muck, 8 feet; total depth reached, 16 feet; no hard bottom reached.

Boring No. 4.—Water, 8 feet; muck, 9 feet; no hard bottom at 17 feet.

Boring No. 5.—Water, 10 feet; muck, 10 feet; no hard bottom at 20 feet.

Boring No. 6.—Water, 5 feet; sand and gravel, 7 feet; muck, 4 feet; no hard bottom at 16 feet.

Boring No. 7.—Water, 8 feet; sand and gravel, 16 feet; no muck; clay was struck at 24 feet.

Boring No. 8.—Water, 18 feet; sand and gravel, 5.5 feet; clay was struck at 23.5 feet.

Boring No. 9.—Water, 18.5 feet; sand and gravel, 6 feet; clay at 24.5 feet.

Boring No. 10.—Water, 25 feet; sand and gravel, 3 feet to hard pan; could not penetrate through it.

Boring No. 11.—Water, 25 feet; sand and gravel, 6.5 feet; struck clay at 31.5 feet.

Boring No. 12.—Water, 26 feet; sand and gravel, 11 feet; struck clay at 37 feet.

Boring No. 13.—Water, 17 feet; sand and gravel, 13 feet; hard pan, 1.5 feet; clay reached at 31 feet.

Boring No. 14.—Water, 19 feet; sand and gravel, 3 feet; hard pan, 1 foot; clay struck at 23 feet.

Boring No. 15.—Water, 8 feet; sand and gravel, 13 feet; a dark muck clay, quite hard, was found at 21 feet.

Boring No. 16.—Water, 2.5 feet; sand and gravel, 7.5 feet; struck muck at 10 feet, and could not penetrate any farther.

Boring No. 17.—Water, 6 feet; sand and gravel, 5.5 feet; conglomerate and hard gravel, 1 foot; sand and gravel, 11 feet, to some hard bottom which could not be penetrated; total depth reached, 17.5 feet.

Boring No. 18.—Water, 4 feet; sand, 6 feet; muck, 21 feet; no hard bottom at 27 feet.

I remain, very respectfully, your most obedient servant,

O. L. PETITDIDIER,
Assistant Engineer.

Maj. JARED A. SMITH,
Corps of Engineers, U. S. A.

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